

Claims

- [c1] 1. A fluid ejection device suitable for an ink-jet printer, comprising:
 - a substrate, having an orifice;
 - a beam, disposed over the substrate, the beam having a fixed portion and a cantilever portion, wherein the cantilever portion is disposed over the orifice; and
 - an activation pad, disposed between the cantilever portion of the beam and the substrate.
- [c2] 2. The fluid ejection device of claim 1, further comprising a stopper, disposed on the cantilever portion of the beam, wherein the stopper is aligned to the orifice of the substrate.
- [c3] 3. The fluid ejection device of claim 2, wherein a dimension of the stopper is larger than that of the orifice.
- [c4] 4. The fluid ejection device of claim 1, wherein the fixed portion of the beam is a collar structure disposed on the substrate for supporting the cantilever portion.
- [c5] 5. The fluid ejection device of claim 1, further comprising an encapsulation structure covering the substrate for encapsulating the beam and the activation pad.

- [c6] 6. A method of fabricating a fluid ejection device, comprising:
- providing a substrate;
- forming an activation pad over the substrate;
- forming a patterned sacrificial layer over the substrate, covering the activation pad, wherein the patterned sacrificial layer comprises an opening exposing a portion of the substrate there-within;
- forming a patterned mold layer over the sacrificial layer, wherein the patterned mold layer comprises a trench exposing the opening;
- forming a first conductive layer in the opening and the trench;
- forming a hole from a backside of the substrate; and removing the patterned sacrificial layer and the mold layer, wherein the first conductive layer forms a beam structure.
- [c7] 7. The method of fabricating a fluid ejection device of claim 6, wherein the step of forming the activation pad on the substrate comprises:
- forming an oxide layer over the substrate;
- forming a second conductive layer over the oxide layer;
- and
- etching the second conductive layer and the mold layer to form the activation pad.

- [c8] 8. The method of fabricating a fluid ejection device of claim 6, wherein the patterned sacrificial layer further comprises an indentation.
- [c9] 9. The manufacturing method of a fluid ejection device of claim 8, wherein, after removing the patterned sacrificial layer and the mold layer, the first conductive layer comprises a stopper connecting thereto that correspond to the indentation.
- [c10] 10. The method of fabricating a fluid ejection device of claim 6, further comprising a step of depositing a seed layer over the patterned sacrificial layer before forming the first conductive layer in the opening and the trench.
- [c11] 11. The method of fabricating a fluid ejection device of claim 6, wherein the step of forming the hole from the backside of the substrate comprises:
 - forming a patterned mask layer over the backside of the substrate for exposing a portion of the backside of the substrate; and
 - etching the exposed portion of the backside of the substrate by using the mask layer as an etching mask to form the hole.
- [c12] 12. The method of fabricating a fluid ejection device of claim 11, further comprising a step of simultaneously

removing the patterned mask layer, the sacrificial layer and the mold layer.

- [c13] 13. The method of fabricating a fluid ejection device of claim 6, wherein the step of forming the hole from the backside of the substrate comprises:
 - forming a first patterned mask layer over the backside of the substrate for exposing a portion of the backside of the substrate;
 - etching the exposed substrate using the first patterned mask layer as an etching mask to form a notch;
 - forming a second patterned mask layer on the backside of the substrate for exposing a portion of a bottom of the notch; and
 - etching the exposed portion of the bottom of the notch using the second patterned mask layer as an etching mask to form the hole.
- [c14] 14. The method of fabricating a fluid ejection device of claim 13, wherein the patterned sacrificial layer, first and second patterned mask layer, and the mold layer are removed simultaneously.
- [c15] 15. The method of fabricating a fluid ejection device of claim 6, wherein the step of forming the hole from the backside of the substrate comprises:
 - forming a first patterned mask layer over the backside of

the substrate for exposing a portion of the backside of the substrate; etching the exposed portion of the backside of the substrate using the first mask layer as an etching mask to form a notch; removing the first patterned mask layer; forming a second patterned mask layer over the backside of the substrate for exposing a portion of a bottom of the notch; and etching the exposed portion of the bottom of the notch using the second patterned mask layer as an etching mask to form the hole.

- [c16] 16. The method of fabricating a fluid ejection device of claim 15, wherein the sacrificial layer, the first and second patterned mask layers, and the mold layer are removed simultaneously.
- [c17] 17. The method of fabricating a fluid ejection device of claim 11, further comprising a step of encapsulating the substrate for protecting the activation pad and the beam after removing the sacrificial layer and the mold layer.
- [c18] 18. A method of operating a fluid ejection device, comprising:
 - providing the fluid ejection device of claim 1;
 - providing a fluid;

filling the fluid into the fluid ejection device; wherein when a voltage is applied to the activation pad, the cantilever portion of the beam is pulled down from an initial position toward the orifice of the substrate for ejecting the fluid out of the orifice; and wherein when the voltage applied to the activation pad is removed, the cantilever portion of the beam gradually moves away from the orifice.

- [c19] 19. The method of operating a fluid ejection device of claim 18, wherein when the voltage applied to the activation pad is removed, the cantilever portion of the beam gradually moves away from the orifice.
- [c20] 20. The method of operating a fluid ejection device of claim 18, wherein when the voltage is applied to the activation pad, the cantilever portion of the beam is pulled down for, contacting the orifice of the substrate and thereby ejecting the fluid from the orifice.